

the 12th, 14th, and 15th; that on the 14th being, with one exception, the highest observed since 1869.

High tides were also observed as follows:

Ocean City, Maryland, 8th.

Jacksonville, Florida, from 15th to 18th.

Indianola, Texas, 28th.

### WATER TEMPERATURE.

The following table gives the highest and lowest temperatures of the water at the several stations; the range of water temperature; the mean temperature of the air at the station; and the depth of water at which the observations are taken:

*Temperature of water for September, 1884.*

Station.	Temperature at bottom.		Range.	Average depth, feet and inches.	Mean temperature of the air at station.
	Max.	Min.			
Atlantic City, New Jersey .....	75.0	69.5	5.5	ft. 2	69.7
Alpena, Michigan .....	72.3	55.8	16.5	12 0	66.5
Augusta, Georgia .....	84.8	78.0	6.8	5 0	76.4
Baltimore, Maryland .....	81.2	71.9	9.3	10 0	72.1
Block Island, Rhode Island .....	68.2	60.7	7.5	7 6	65.3
Boston, Massachusetts .....	65.5	57.1	8.4	21 2	65.8
Buffalo, New York .....	75.0	65.4	9.6	9 11	65.6
Canby, Fort, Washington Territory .....	62.5	50.7	11.8	10 10	55.3
Cedar Keys, Florida .....	86.2	79.9	6.3	10 10	80.3
Charleston, South Carolina .....	83.2	75.2	8.0	39 4	77.2
Chicago, Illinois .....	66.9	58.7	8.2	5 0	68.9
Chincoteague, Virginia .....	82.4	68.5	13.9	4 0	71.8
Cleveland, Ohio .....	75.1	64.3	10.8	14 0	67.3
Detroit, Michigan .....	75.6	62.9	12.7	23 10	68.4
Delaware Breakwater, Delaware .....	76.7	68.3	8.5	8 10	70.6
Duluth, Minnesota .....	65.1	52.4	12.7	10 2	57.5
Eastport, Maine .....	52.0	50.5	1.5	14 11	52.5
Escanaba, Michigan .....	66.0	59.1	6.9	18 3	60.1
Galveston, Texas .....	87.3	80.2	7.1	12 11	83.5
Grand Haven, Michigan .....	77.5	64.2	13.3	19 0	65.4
Indianola, Texas .....	80.2	77.5	2.7	9 3	81.0
Jacksonville, Florida .....	85.2	79.3	5.9	18 0	77.8
Key West, Florida .....	87.9	81.7	6.2	17 3	82.2
Mackinaw City, Michigan .....	65.1	56.2	8.9	10 0	60.6
Macon, Fort, North Carolina .....	84.0	79.6	4.4	8 10	75.5
Marquette, Michigan .....	60.5	55.6	4.9	10 0	59.0
Milwaukee, Wisconsin .....	57.8	43.1	14.7	8 0	64.0
Mobile, Alabama .....	85.6	80.0	5.6	17 2	78.3
New Haven, Connecticut .....	76.7	65.0	11.7	10 0	66.4
New London, Connecticut .....	69.6	64.2	5.4	12 6	65.9
New York City .....	74.4	67.4	7.0	16 2	69.6
Norfolk, Virginia .....	80.8	72.7	8.1	16 2	73.9
Pensacola, Florida .....	85.3	82.3	3.0	17 8	79.5
Portland, Maine .....	59.8	54.4	5.4	15 3	64.0
Portland, Oregon .....	71.0	59.5	11.5	53 0	55.7
Sandusky, Ohio .....	79.0	62.5	16.5	10 3	68.8
Sandy Hook, New Jersey .....	75.3	64.0	11.3	1 8	70.4
San Francisco, California .....	84.3	57.5	26.8	37 3	58.3
Savannah, Georgia .....	84.3	70.0	14.3	10 9	76.4
Smithville, North Carolina .....	82.5	73.0	9.5	10 9	75.9
Toledo, Ohio .....	77.6	65.7	11.9	11 2	69.3
Wilmington, North Carolina .....	82.0	72.0	10.0	20 1	75.2

### VERIFICATIONS.

#### INDICATIONS.

The detailed comparison of the tri-daily indications for September, 1884, with the telegraphic reports for the succeeding twenty-four hours, shows the general average percentage of verifications to be 81.58 per cent. The percentages for the four elements are: Weather, 88.64; direction of the wind, 77.00; temperature, 77.89; barometer, 84.49 per cent. By geographical districts, they are: For New England, 78.28; middle Atlantic states, 83.87; south Atlantic states, 88.42; eastern Gulf states, 86.67; western Gulf states, 86.20; lower lake region, 77.39; upper lake region, 77.97; Ohio valley and Tennessee, 84.77; upper Mississippi valley, 78.52; Missouri valley, 72.64; north Pacific coast region, 83.33; middle Pacific coast region, 90.83; south Pacific coast region, 98.33. There were five omissions to predict out of 2,948, or 0.17 per cent. Of the 2,943 predictions that have been made, ninety-eight, or 3.33 per cent., are considered to have entirely failed; one hundred and sixty-seven, or 5.68 per cent., were one-fourth verified; three hundred and fifty-four, or 12.03 per cent., were one-half verified; five hundred and sixty-seven, or 19.26 per cent., were three-fourths verified; 1,757, or 59.70 per cent., were fully verified, so far as can be ascertained from the tri-daily reports.

### CAUTIONARY SIGNALS.

During September, 1884, one hundred and forty cautionary signals were ordered. Of these, ninety-one, or 65.0 per cent., were justified by winds of twenty-five miles or more per hour at or within one hundred miles of the station. Twenty-six off-shore signals were ordered, of which number sixteen, or 61.54 per cent., were fully justified, both as to direction and velocity; twenty, or 76.92 per cent., were justified as to direction; and twenty-one, or 80.77 per cent., were justified as to velocity. One hundred and sixty-six signals of all kinds were ordered, one hundred and seven, or 64.46 per cent., being fully justified. These do not include signals ordered at display stations where the velocity of the wind is only estimated. Three signals were ordered late. In sixty-four cases winds of twenty-five miles or more per hour were reported, for which no signals were ordered.

Concerning the system of indicating the weather changes by means of railway signals, Professor Mell, director of the "Alabama Weather Service," states that this system has been in successful operation over a large part of that state, and that the reports received by him indicate that much interest is manifested wherever the signals have been displayed. These signals were displayed from the 11th to the close of the month, and a high percentage of verification was attained. Out of the reports from nine stations, six reported that the indications referring to temperature were fully verified; five reported the indications referring to the character of the weather fully verified; and the remaining stations reported percentages of accuracy varying from 85 to 95 per cent.

### ATMOSPHERIC ELECTRICITY.

#### AUROSAS.

Brilliant and extensively observed auroral displays occurred on the evenings of the 13th and 17th; that which occurred on the last-mentioned date being observed throughout the northern portions of the United States and in British America. It was seen at Sidney, Nova Scotia, on the east; at stations on the coasts of Oregon and Washington Territory on the west; and southward to stations in southern Illinois and Indiana, and the central portions of Ohio and Kansas.

The display on the 13th, was not observed to the west of Dakota but was reported by numerous stations from the upper Missouri valley eastward to the Atlantic coast. The following reports relate to the display:

Eastport, Maine, 13th: an auroral arch was visible from 7.50 p. m. until 2 a. m. of the 14th; it extended to an altitude of 25°; several streamers of whitish color were observed during the display.

Point Judith, Rhode Island, 13th: a faint auroral light appeared at 7.50 p. m.; at 8.10 p. m. an arch of pale straw color formed, and remained visible until after midnight; the arch extended from northwest to northeast, being about 5° in width and 12° altitude; a dark haze was observed beneath the arch; no streamers were seen.

Menand Station (near Albany), New York: at 10.15 p. m., on the 13th, auroral beams of from 5° to 10° altitude were observed.

Moorestown, New Jersey: from 10.45 to 11.15 p. m. on the 13th, a few auroral streamers were observed.

Oswego, New York: an auroral light of pale straw color appeared at 10.50 p. m.; only a few streamers were noticed; the light faded gradually and by 12.50 a. m. it had entirely disappeared.

Rochester, New York: from 9.30 to 10.10 p. m., on the 13th, an aurora was visible in the northern sky; beams of light suddenly shot upward to a height of 45° and were followed by a wave of light having a slow motion from west to east.

Thornville, Michigan: a faint auroral display was visible from 9 to 11 p. m., on the 13th.

Riley, Illinois: a poorly-defined auroral arch of unusual brilliancy was observed at 10 p. m., on the 13th.

Summary of meteorological data for stations of the Signal Service, Sept., 1884.

Stations.	Elevation above sea-level.	Mean barometer corrected for temperature and error.	Departure from normal.	Temperature.	Wind.	Rainfall.
				Monthly mean.	Direction.	
				Departure from normal.	Max. velocity.	
				Maximum.	Date.	
				Minimum.	Date.	
				Prevailing direction.	Total movement.	
<b>New England.</b>						
Block Island.....	27	30.07	+0.03	65	10.49 14 s.w.	32
Boston.....	142	29.92	+0.01	68	10.40 14 s.w.	25.0
Eastport.....	61	29.94	.....	56	10.40 14 s.w.	29.8
Mount Washington.....	6,279	23.58	-0.01	41	10.40 14 s.w.	26.0
New Haven.....	107	29.98	+0.03	66	10.40 14 s.w.	22.8
New London.....	47	30.06	+0.03	67	10.45 15 s.w.	23.8
Portland.....	45	30.00	+0.01	64	10.40 14 s.w.	28.0
<b>Middle Atlantic states.</b>						
Albany.....	75	30.00	+0.01	68	10.42 14 s.w.	22.8
Atlantic City.....	13	30.09	+0.04	70	10.40 14 s.w.	27.8
Baltimore.....	45	30.07	+0.04	72	10.40 14 s.w.	18.8
Barnegat City.....	22	30.09	+0.05	69	10.40 14 s.w.	32.8
Cape Henry.....	16	30.11	+0.06	74	10.40 14 s.w.	41.0
Cape May.....	27	30.08	+0.05	71	10.40 14 s.w.	32.8
Chincoteague.....	8	30.11	+0.07	72	10.40 14 s.w.	44.0
Delaware Breakwater.....	30	30.10	+0.06	71	10.40 14 s.w.	58.0
Lynchburg.....	652	29.44	+0.05	72	10.40 14 s.w.	20.8
New York.....	104	29.94	+0.04	70	10.40 14 s.w.	32.8
Norfolk.....	30	30.10	+0.07	74	10.40 14 s.w.	22.8
Philadelphia.....	117	30.00	+0.04	71	10.40 14 s.w.	38.8
Sandy Hook.....	28	30.08	+0.04	70	10.40 14 s.w.	39.0
Washington.....	106	30.02	+0.05	72	10.40 14 s.w.	19.0
<b>South Atlantic states.</b>						
Atlanta.....	1,129	28.96	+0.04	75	10.40 14 s.w.	28.0
Augusta.....	183	29.94	+0.04	70	10.40 14 s.w.	22.0
Charleston.....	52	30.02	+0.01	70	10.40 14 s.w.	32.0
Charlotte.....	868	29.90	+0.08	73	10.40 14 s.w.	17.0
Fort Macon.....	11	30.12	+0.07	76	10.40 14 s.w.	44.0
Hatteras.....	12	30.10	+0.05	75	10.40 14 s.w.	32.0
Jacksonville.....	43	30.02	+0.02	78	10.40 14 s.w.	21.0
Kitty Hawk.....	22	30.12	+0.06	75	10.40 14 s.w.	50.0
Savannah.....	87	29.99	+0.02	76	10.40 14 s.w.	24.0
Smithville.....	34	30.09	+0.06	76	10.40 14 s.w.	32.0
Wilmington.....	52	30.00	+0.05	75	10.40 14 s.w.	22.0
<b>Eastern Gulf states.</b>						
Mobile.....	35	30.02	+0.03	78	10.40 14 s.w.	24.0
Montgomery.....	219	29.84	+0.01	79	10.40 14 s.w.	16.0
New Orleans.....	52	29.97	+0.00	81	10.40 14 s.w.	24.0
Pensacola.....	30	30.02	+0.01	80	10.40 14 s.w.	21.0
Vicksburg.....	244	29.81	+0.01	78	10.40 14 s.w.	21.0
<b>Western Gulf states.</b>						
Fort Smith.....	451	29.52	-0.07	77	10.40 14 s.w.	14.0
Galveston.....	40	29.96	-0.01	84	10.40 14 s.w.	27.0
Indianola.....	26	29.95	-0.02	81	10.40 14 s.w.	37.0
Little Rock.....	299	29.71	-0.02	77	10.40 14 s.w.	24.0
Palestine.....	533	29.46	-0.06	80	10.40 14 s.w.	27.0
Shreveport.....	227	29.78	-0.02	80	10.40 14 s.w.	16.0
<b>Ohio valley &amp; Tennessee.</b>						
Chattanooga.....	783	29.39	+0.02	73	10.40 14 s.w.	20.0
Cincinnati.....	620	29.44	+0.01	74	10.40 14 s.w.	21.0
Columbus.....	805	29.43	+0.01	71	10.40 14 s.w.	39.0
Indianapolis.....	753	29.20	-0.02	72	10.40 14 s.w.	18.0
Knoxville.....	980	29.10	-0.02	72	10.40 14 s.w.	28.0
Louisville.....	530	29.51	+0.03	74	10.40 14 s.w.	25.0
Memphis.....	321	29.74	+0.01	77	10.40 14 s.w.	27.0
Nashville.....	549	29.50	+0.01	74	10.40 14 s.w.	27.0
Pittsburg.....	756	29.28	-0.01	70	10.40 14 s.w.	24.0
<b>Lower lake region.</b>						
Buffalo.....	690	29.33	+0.01	66	10.40 14 s.w.	44.0
Cleveland.....	690	29.34	+0.01	67	10.40 14 s.w.	40.0
Detroit.....	661	29.35	+0.00	68	10.40 14 s.w.	38.0
Erie.....	681	29.34	+0.01	67	10.40 14 s.w.	30.0
Oswego.....	334	29.09	-0.03	64	10.40 14 s.w.	30.0
Rochester.....	121	29.40	+0.02	65	10.40 14 s.w.	30.0
Sandusky.....	639	29.39	+0.01	69	10.40 14 s.w.	42.0
Toledo.....	651	29.35	+0.01	69	10.40 14 s.w.	38.0
<b>Upper lake region.</b>						
Alpena.....	609	29.31	-0.06	60	10.40 14 s.w.	48.0
Chicago.....	661	29.31	-0.02	69	10.40 14 s.w.	41.0
Duluth.....	687	29.10	-0.08	60	10.40 14 s.w.	41.0
Escanaba.....	613	29.27	-0.08	60	10.40 14 s.w.	30.0
Grand Haven.....	630	29.35	-0.02	61	10.40 14 s.w.	35.0
Mackinaw City.....	695	29.32	-0.11	60	10.40 14 s.w.	35.0
Marquette.....	673	29.21	-0.07	60	10.40 14 s.w.	35.0
Milwaukee.....	667	29.25	-0.03	64	10.40 14 s.w.	35.0
Port Huron.....	633	29.33	-0.03	65	10.40 14 s.w.	37.0
<b>Upper Mississippi valley.</b>						
Calro.....	377	29.68	-0.01	74	10.40 14 s.w.	29.0
Davenport.....	615	29.33	-0.05	70	10.40 14 s.w.	25.0
Des Moines.....	849	29.07	-0.06	68	10.40 14 s.w.	28.0
Dubuque.....	665	29.27	-0.05	68	10.40 14 s.w.	28.0
Keokuk.....	618	29.34	-0.03	71	10.40 14 s.w.	28.0
La Crosse.....	725	29.17	-0.06	67	10.40 14 s.w.	28.0
Saint Louis.....	583	29.42	-0.02	74	10.40 14 s.w.	28.0
Saint Paul.....	801	29.05	-0.07	64	10.40 14 s.w.	28.0
Springfield.....	644	29.37	-0.06	71	10.40 14 s.w.	28.0
<b>Missouri valley.</b>						
Fort Bennett.....	1,510	28.30	-0.09	62	10.40 14 s.w.	32.0
Huron.....	1,305	28.50	-0.10	60	10.40 14 s.w.	34.0
Leavenworth.....	842	29.07	-0.07	72	10.40 14 s.w.	29.0
Omaha.....	1,113	28.77	-0.09	69	10.40 14 s.w.	30.0
Yankton.....	1,228	28.60	-0.10	64	10.40 14 s.w.	33.0

Summary of meteorological data for stations of the Signal Service, Sept., 1884.—Continued.

Stations.	Elevation above sea-level.	Mean barometer corrected for temperature and error.	Departure from normal.	Temperature.	Wind.	Rainfall.
				Monthly mean.	Direction.	
				Departure from normal.	Max. velocity.	
				Maximum.	Date.	
				Minimum.	Date.	
				Prevailing direction.	Total movement.	
<b>Extreme northwest.</b>						
Moorhead.....	623	28.87	-0.12	57	10.40 14 s.w.	40.0
Bismarck.....	1,694	28.07	-0.10	56	10.40 14 s.w.	35.0
Fort Buford.....	1,950	27.85	-0.16	52	10.40 14 s.w.	46.0
Saint Vincent.....	804	28.96	-0.11	54	10.40 14 s.w.	33.0
Fort Totten.....	28.25	.....	.....	54	10.40 14 s.w.	31.0
<b>Pacific coast region.</b>						
Cape Mendocino.....	637	29.32	+0.04	56	10.40 14 s.w.	62.0
Fort Canby.....	179	29.78	.....	55	10.40 14 s.w.	48.0
Los Angeles.....	371	29.58	-0.06	55	10.40 14 s.w.	48.0
Olympia.....	36	29.96	-0.05	55	10.40 14 s.w.	17.0
Portland.....	67	29.95	-0.02	56	10.40 14 s.w.	19.0
Red Bluff.....	332	29.58	-0.03	57	10.40 14 s.w.	26.0
Roseburg.....	.....	.....	.....	57	10.40 14 s.w.	.....
Sacramento.....	64	29.86	+0.02	55	10.40 14 s.w.	27.0
San Diego.....	67	29.85	+0.01	55	10.40 14 s.w.	19.0
San Francisco.....	60	29.91	+0.02	58	10.40 14 s.w.	30.0
<b>Northern slope.</b>						
Assiniboine.....	2,720	27.08	-0.09	50	10.40 14 s.w.	50.0
Cheyenne.....	6,105	24.01	-0.08	56	10.40 14 s.w.	45.0
Deadwood.....	4,600	25.33	-0.07	53	10.40 14 s.w.	22.0
Fort Benton.....	2,681	27.15	-0.07	53	10.40 14 s.w.	40.0
Fort Custer.....	3,040	26.77	-0.08	54	10.40 14 s.w.	36.0
Fort Maginnis.....	4,340	25.50	-0.14	47	10.40 14 s.w.	40.0
Fort Shaw.....	3,550	26.30	-0.09	48	10.40 14 s.w.	42.0
Helena.....	4,044	25.79	-0.09	50	10.40 14 s.w.	29.0
Poplar River.....	.....	.....	.....	52	10.40 14 s.w.	.....
Spokane Falls.....	1,906	27.92	-0.05	52	10.40 14 s.w.	19.0
<b>Middle slope.</b>						
Denver.....	5,294	24.72	-0.09	65	10.40 14 s.w.	48.0
Dodge City.....	2,517	27.35	-0.11	70	10.40 14 s.w.	42.0
Fort Elliott.....	2,650	27.22	-0.07	73	10.40 14 s.w.	40.0
North Platte.....	2,841	27.00	-0.10	65	10.40 14 s.w.	36.0
Pike's Peak.....	14,134	17.95	-0.01	32	10.40 14 s.w.	28.0
West Las Animas.....	3,899	25.97	-0.13	67	10.40 14 s.w.	29.0
<b>Southern slope.</b>						
Fort Concho.....	1,900	28.06	-0.05	78	10.40 14 s.w.	35.0
Fort Davis.....	4,928	25.22	-0.03	69	10.40 14 s.w.	20.0
Fort Sill.....	1,200	28.71	-0.09	78	10.40 14 s.w.	36.0
Fort Stockton.....	3,010	26.97	-0.05	75	10.40 14 s.w.	30.0
<b>Northern plateau.</b>						
Boise City.....	2,750	27.15	-0.03	55	10.40 14 s.w.	21.0
Dayton.....	1,607	28.23	-0.04	54	10.40 14 s.w.	27.0
Lewiston.....	780	29.16	-0.00	57	10.40 14 s.w.	19.0
<b>Middle plateau.</b>						
Salt Lake City.....	4,348	25.50	-0.06	59	10.40 14 s.w.	29.0
<b>Southern plateau.</b>						
Camp Thomas.....	2,710	27.18	-0.02	73	10.40 14 s.w.	.....
El Paso.....	3,764	26.24	-0.04	73	10.40 14 s.w.	14.0
Fort Apache.....	5,050	25.02	-0.04	61	10.40 14 s.w.	26.0
Fort Grant.....	4,856	25.22	-0.06	71	10.40 14 s.w.	29.0
Prescott.....	5,889	24.74	-0.02	60	10.40 14 s.w.	34.0
Yuma.....	.....	.....	.....	60	10.40 14 s.w.	.....
<b>Rio Grande valley.</b>						
Brownsville.....	59	29.88	-0.05	80	10.40 14 s.w.	28.0
Rio Grande City.....	230	29.74	-0.03	83	10.40 14 s.w.	28.0
<b>Florida peninsula.</b>						
Cedar Key.....	22	30.03	+0.02	80	10.40 14 s.w.	33.0
Key West.....	26	29.98	+0.01	82	10.40 14 s.w.	32.0
Sanford.....	36	29.96	+0.02	78	10.40 14 s.w.	28.0

Cresco, Iowa: at 8.20 p. m., on the 13th, a low auroral arch was observed with a few faint streamers at its eastern extremity.

Alpena, Michigan: at 8.45 p. m., of the 13th, an auroral display was observed, consisting of a dark segment from which brilliant streamers extended nearly to the zenith; the streamers appeared and disappeared alternately and had an apparent motion from west to east. The display ended at 1.30 a. m., on the 14th.

Escanaba, Michigan: an aurora appeared at 7.17 p. m., on the 13th; it was of a yellowish color, and rested on a dark segment, the light extending from the western to the eastern horizon; at 8.57 p. m., bright yellow beams rose slowly from the dark segment to a height of 40°. The display continued until 10.40 p. m.

Grand Haven, Michigan: faint rose-colored auroral streamers extending upward 55°, were observed from 9.10 to 11.35 p. m., on the 13th.

in the north during the evening of the 13th. An arch of white light extended across the sky from northwest to southeast, passing south of the zenith. At 11 p. m., waves of white light flashed upward to a height of 45° from a dark cloud in the north.

Duluth, Minnesota: at 9.30 p. m., on the 13th, an auroral light of yellowish green color, was observed, extending from 160° to 220°, azimuth; a few faint beams were observed at intervals during the display. At 10.35 p. m., a well defined and bright beam shot upward from azimuth 160, and extended to the zenith, having a width of about one half degree; from the zenith it inclined eastward to about 220° degrees, azimuth, tapering to a point, and fading out at about 20° above the horizon; this beam remained visible for eight minutes. The display was obscured by clouds at 11.30 p. m.

Saint Paul, Minnesota: an auroral display in the form of a segment of pale straw-colored light, with a dark slate-colored base, was observed between 8.55 and 9.25 p. m. on the 13th. The light extended from 175° to 205°, azimuth, and to a height of 15° at the centre. At 9.15 p. m., a few slender beams shot upward to a height of 30°; these vanished and reappeared in rapid succession from 9.15 to 9.25 p. m.

Moorhead, Minnesota: a part of an auroral arch of 12° altitude was seen through the broken clouds in the northern sky on the evening of the 13th.

Saint Vincent, Minnesota: an auroral light appeared at 8.15 p. m. of the 13th; it consisted of a well-defined arch extending across the northern sky, having an altitude of 30° at its centre. Bright streamers flashed upward from the arch, nearly reaching the zenith, and afterwards fading away. Beneath the arch there was an incessant display of lightning from cumulo-stratus clouds, while between the latter and the arch the stars shone brightly. The display was hidden by clouds at 11 p. m.

Fort Totten, Dakota: an auroral light appeared in the north at 8.30 p. m. on the 13th; at 9 p. m. a single beam extended from the eastern to the northwestern horizon, passing through the zenith. This beam was about 2° in width and remained very bright for about one hour, while the northern sky was illuminated by a beautiful arch with a dark segment beneath, where rapid flashes of sheet lightning were observed. The display ended at 11.20 p. m.

Fort Yates, Dakota: a fine auroral display appeared at 7 p. m., on the 13th; it consisted of two luminous bands, which reached their greatest brilliancy at 9.30 p. m. The display continued until 2.30 a. m. of the 14th.

The following reports relate to the display observed on the 17th:

Eastport, Maine: an auroral arch of whitish color and of 25° altitude at its centre, was observed from 7.50 to 11 p. m., on the 17th.

Portland, Maine: an aurora was visible from 8.45 p. m. on the 17th to 2 a. m. on the 18th. It first appeared as a dim light, which gradually assumed the form of a band of whitish light having a fold in itself near the centre. As the band decreased in brilliancy, rays of light appeared, reaching to the zenith.

New London, Connecticut, 17th: a faint aurora became visible at 8.10 p. m. and continued until obscured by clouds at 10.15 p. m.

Point Judith, Rhode Island: from 9 p. m. of the 17th until after midnight an auroral light was observed through the openings in the clouds.

Ithaca, New York: a faint auroral light was seen through the clouds on the evening of the 17th.

Hiram, Ohio: a distinct auroral light was observed in the east at 9 p. m. on the 17th.

Sandusky, Ohio: a faint aurora appeared at 10.38 p. m. of the 17th. At midnight, a bright band, which remained visible fifteen minutes, extended across the sky from the northwest to southeast.

Toledo, Ohio: at 8 p. m. on the 17th an auroral arch having

an altitude of about 10° and resting on a dark segment, appeared in the northern sky. The display continued with varying brilliancy until 1.30 a. m. of the 18th.

Wilton Centre, Illinois: at 10 p. m. on the 17th was observed an auroral light consisting of a well-defined arch, the centre of which was of about 25° altitude. This display was also seen at Sycamore and Swanwick in this state.

Vevay, Indiana: a faint auroral light was observed at 10 p. m. on the 17th.

Spiceland, Indiana: an auroral glow was visible at 9 p. m. on the 17th; no streamers were observed.

Wabash, Indiana: an aurora was observed at 10 p. m. on the 17th.

Ionia, Michigan: an aurora was visible from 8.30 to 10.30 p. m. on the 17th.

Escanaba, Michigan: an aurora appeared at 8.20 p. m. on the 17th; the light was at first partly obscured by clouds, but as the clouds disappeared it became very bright, at 10.35 p. m., numerous beams rose slowly from behind the clouds, and at 10.47, flashes of bright yellow light extended from northwest to northeast, and to within 10° of the zenith.

La Crosse, Wisconsin: on the 17th at 8 p. m. an aurora, consisting of an arch of light resting on a dark segment, extended over above 60° of the northern sky. The centre of the arch was about 6° east of the magnetic meridian, and of about 25° altitude; the display gradually faded, no traces of it remaining at 2 a. m.

Keokuk, Iowa: a faint auroral light, extending over about 100° of the northern horizon, was observed at 9.45 p. m., on the 17th; it was of pale straw-color, and extended upward 15°. The display was brightest at 10.15 p. m., when two streamers shot upward from the northern horizon to an altitude of 50°. At 11 p. m. the display was very indistinct.

Davenport, Iowa: at 10 p. m. of the 17th a bright straw-colored, auroral light extended over about 90° of the northern horizon, and to an altitude of 30°; at 10.30 p. m. a complete arch was formed, with bright streamers reaching a height of 45°. The display ended at 11.30 p. m.

Duluth, Minnesota: an aurora appeared at 7.30 p. m. on the 17th; at 8.10 two arches were visible, their centres being of about 30° and 45° altitude, respectively. Both of these arches were poorly defined; they disappeared at 10 p. m., leaving only a pale, green light with occasional streamers, which remained visible until 3.20 a. m.

Moorhead, Minnesota: faint auroral streamers were seen at 7.30 p. m. on the 17th; at 9 p. m. flashes of light rolled upward from a point slightly east of north toward the zenith. Cloudiness partially obscured the display, which was still visible at midnight.

Bismarck, Dakota: a brilliant auroral display was visible on the 17th at 9.30 p. m., at which time the northern horizon was partially obscured by stratus clouds; auroral streamers of deep red color extended to a height of 45°; at 10.00 p. m. the converging streamers formed at the zenith a beautiful corona, which had a quivering motion. The telegraph wires were affected during the display, communication between this place and Saint Paul, Minnesota, being seriously interfered with.

Huron, Dakota: from 8 p. m. until nearly midnight on the 17th a bright auroral arch extended across the sky from northwest to northeast; at midnight a band of white light spanned the sky from west to east, passing through the zenith; this band remained visible for forty minutes.

Genoa, Nebraska: a fine display of the aurora was observed on the evening of the 17th. This display was also observed at Yutan, Red Willow, Marquette and Crete, Nebraska.

Salina, Kansas: a bright, yellow auroral light was observed during the evening of the 17th.

Allison, Kansas: between 8 and 9 p. m. on the 17th, a faint auroral glow was observed; the light increased in brilliancy from 9 to 9.45 p. m., when streamers extending upward 25° were visible.

Sherlock, Kansas: from 8 to 9 p. m. on the 17th, was ob-

served a moderately bright aurora, reaching from the horizon to a bank of clouds about 10° above.

Poplar River, Montana: an auroral light of pale blue color, covering 20° of the northern sky, was visible from 8.30 to 11 p. m. on the 17th.

Fort Benton, Montana: brilliant auroral beams were visible from 7 to 9.30 p. m. on the 17th; they covered the sky from northwest to northeast and extended to an altitude of 90°. The beams were observed to have a very slight movement.

Helena, Montana: on the 17th an auroral display was visible from 8 to 8.20 p. m., after which it became obscured.

Lewiston, Idaho: on the 17th at 7.30 p. m. an auroral light covered the sky from northwest to north-northeast, and to an altitude of 30°. It first appeared as a dark segment from which numerous bright streamers flashed upward, fading and reappearing at short intervals. The display was brightest at 8 p. m., when "merry dancers" extended from west to east, flashing across the northern horizon, and reaching a height of 45°; after 8 p. m. the aurora began to fade, and by 9 p. m. it had entirely disappeared.

Dayton, Washington Territory: a bright auroral display was observed from 7 to 9.40 p. m. on the 17th; bright yellow streamers were visible for fifteen minutes; at 9 p. m. a pale white arch remained visible.

Astoria, Oregon: a fine auroral display was observed between 8.30 and 9.15 p. m., on the 17th; it consisted of long, slender beams of pale yellow color, rising from a dark base, and shooting upwards to heights of from 30° to 90°.

Pleasant Grove, Washington Territory: an auroral arch with "merry dancers" was observed from 9 to 11 p. m. on the 17th. This display was also seen at Crescent bay.

Auroral displays occurred on other dates during the month as follows:

3d.—Fort Yates, Dakota.

10th.—Eastport, Maine.

12th.—Williamstown and Thatcher's Island, Massachusetts; Prairie du Chien, Wisconsin; Point Judith, Rhode Island.

14th.—Cornish, Gardiner, and Portland, Maine; Oswego and Syracuse, New York; Burlington, Vermont; Lancaster, Wisconsin.

15th.—Cornish, Maine; Chester, Minnesota; Burlington, Iowa.

18th.—Bismarck, Fort Buford, Fort Totten, Fort Yates, and Webster, Dakota; Orono and Eastport, Maine; Traverse City, Michigan; Duluth and Moorhead, Minnesota.

21st.—Yutan, Nebraska.

26th.—Mountainville, New York.

#### THUNDER-STORMS.

Thunder-storms were reported in the following districts as follows:

*New England.*—6th, 7th, 8th, 10th, 11th, 14th, 15th, 18th to 23d, 25th, 26th, 28th, 29th.

*Middle Atlantic states.*—6th to 12th, 14th, 17th, 20th to 23d, 25th, 27th to 30th.

*South Atlantic states.*—5th, 7th to 10th, 12th, 18th, 20th, 21st, 22d, 25th, 26th, 30th.

*Florida peninsula.*—1st to 6th, 9th to 13th, 15th to 30th.

*East Gulf states.*—2d, 3d, 6th, 8th, 9th, 20th, 21st, 24th, 27th, 28th.

*West Gulf states.*—3d, 4th, 5th, 7th to 17th, 19th to 30th.

*Rio Grande valley.*—4th, 7th to 11th, 13th, 14th, 19th, 20th, 27th, 28th, 30th.

*Tennessee.*—3d, 6th to 11th, 16th, 17th, 19th to 24th, 26th to 30th.

*Ohio valley.*—5th, 7th to 12th, 15th, 17th to 24th, 27th to 30th.

*Lower lake region.*—4th to 11th, 13th, 17th to 20th, 22d, 23d, 24th, 27th, 28th, 29th.

*Upper lake region.*—1st to 10th, 14th, 15th, 16th, 19th to 24th, 26th to 30th.

*Extreme northwest.*—1st, 2d, 5th, 8th, 9th, 10th, 12th to 15th, 18th, 21st, 22d.

*Upper Mississippi valley.*—1st to 11th, 13th to 19th, 21st to 24th, 26th to 30th.

*Missouri valley.*—1st to 10th, 12th to 16th, 18th to 23d, 25th to 30th.

*Northern slope.*—3d, 6th, 7th, 9th, 14th, 18th.

*Middle slope.*—1st to 10th, 12th to 16th, 18th, 19th, 20th, 22d to 27th, 30th.

*Southern slope.*—3d to 7th, 9th to 12th, 22d, 26th.

*Southern plateau.*—1st to 8th, 10th, 12th, 13th, 14th, 15th, 19th to 23d, 25th, 31st.

*Middle plateau.*—2d, 12th, 13th, 14th, 22d.

*North Pacific coast region.*—5th, 10th, 11th, 27th, 28th, 29th.

*Middle Pacific coast region.*—4th, 6th, 8th, 12th, 13th, 14th, 30th.

Thunder-storms were also reported at the following stations, not included in the districts named above:

San Diego, California, 20th.

Cœur d'Alene, Idaho, 14th.

Professor H. A. Hazen, of the Signal Service, has prepared the following notes on the thunder storms of September, 1884:

Reports from special voluntary observers from north of lat. 35° and east of 102° west longitude. The total number of reports received was 1,575; of these the largest number were: for storms on the 7th, 85; 8th, 105; 9th, 111; 10th, 132; 11th, 86; 22d, 89; 23d, 78, and 28th, 76.

On the 7th, action was general in Missouri, Illinois, Indiana and Ohio, to southeast of a large trough of low pressure lying between two "highs," also in New England at about 420 miles southeast of "low."

On the 8th and 9th there were frequent storms in Iowa, Wisconsin and Illinois, 450 miles to southeast and east of "low." These storms on the 9th were all about the tornadoes which occurred in Iowa and Wisconsin.

The most general action occurred on the 10th. It seems probable that there were two centers for these storms, the one in Iowa and the other in Ohio; the first note of them was at 1 p. m., and they gradually worked east, the first disappearing about 9 p. m. in southern Indiana and the second at 8 p. m., off the Atlantic coast. The mean distance from "low" was about 500 miles to southeast and south.

On the 11th general action occurred in Pennsylvania, New Jersey, New York and Massachusetts, about 400 miles south-southeast of "low."

On the 27th general action occurred to south of "low" about 450 miles, in Illinois, Indiana and Ohio. The hurricanes of this date in Ohio were just to the north of the most frequent storms.

On the 28th action began in Indiana at 8 a. m., 600 miles to southeast of "low," from thence passing nearly due east, it culminated in terrific winds and even tornado action at 5 p. m. in Alton, Pennsylvania, and at 6.20 p. m. in Shongo, New York, thence passing eastward, the last noted was in Heath, Massachusetts, from 11 p. m. to midnight.

On the 30th general action is recorded in Illinois and Indiana, 550 miles south of "low."

The records in both August and September indicate an intimate relation between the "low" centre and the region of general thunder-storm action, the latter occurring in a south or southeast direction at a mean distance of 450 to 500 miles. It should be understood, however, that a well-defined "low" is not always accompanied by such action in summer. In nearly every instance specially noted in August and this month the "low" has been of medium or light intensity.

It has also been noted that while there are occasional cloud-bursts and enormous rainfalls in connection with the storms, yet such rainfall has not been as general over a large region as in the case of well-defined "lows." This suggests the idea that possibly a general rain allows the electricity to pass to the earth by insensible degrees and thus prevents its accumulation in sufficient amount to produce thunder-storm action.

TABLE I.—Mean number of thunder-storms in September at each station, by districts.

District.	1854-1873.		1884.		Difference.	
	Stations.	No.	Stations.	No.	Stations.	No.
I.....	20	1.84	44	2.52	24	+.68
II.....	15	2.20	60	1.47	45	-.79
III.....	20	2.60	90	2.93	70	+.33
IV.....	9	2.78	20	3.15	11	+.37
V.....	11	2.85	61	3.44	50	+.59
Total.....	75	2.39	275	2.68	203	+.29

In order to compare the records for this September with those of voluntary observers for the same month between the years 1854 and 1873 Table i. has been prepared.

In this, column one shows the districts defined as follows: i., New England and New York; ii., Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia; iii., Illinois, Indiana, Kentucky,

Ohio, and Tennessee; iv., Michigan, Minnesota, and Wisconsin; v., Dakota, Iowa, Kansas, Missouri, Montana, and Nebraska. Column two shows the mean number of stations in each district for twenty years. Column three shows the mean number of storms at each station. Columns four and five give stations and mean number of storms for 1884. Column six gives the excess of stations in the present year, and the last column gives the excess or deficiency in storms for 1884 as compared with the mean of twenty years. Every district but one, it will be noted, shows an increase. The large deficiency in district ii. is readily accounted for when we consider that in this district there has been a protracted drought, and the conditions producing that were unfavorable to the development of thunder-storms.

TABLE II.—Mean number of thunder-storms per station in all districts for September.

Year.	Stations.	No.	Departure.	Magnetic Declination.	Departure.	Year.	Stations.	No.	Departure.	Magnetic Declination.	Departure.
1851.....	46	2.22	— .16			1864.....	37	2.24	— .30	3.40	— .18
1852.....	32	1.94	— .45			1865.....	70	2.08	— .30	2.67	— .55
1853.....				4.29	1.07	1866.....	94	1.83	— .55	2.59	— .63
1854.....	90	2.64	.26	3.21	— .01	1867.....	106	1.59	— .79	1.81	— 1.41
1855.....	58	2.89	.51	3.23	.01	1868.....	105	2.43	.05	2.94	— .26
1856.....	70	2.10	— .38	2.72	— .50	1869.....	89	1.97	— .41	2.84	— .38
1857.....	65	2.74	.36	3.79	.57	1870.....	33	2.39	.01	4.09	.87
1858.....	57	2.02	.33	2.83	— .01	1871.....	90	1.41	.57	3.39	.17
1859.....	56	2.10	— .38	3.71	.49	1872.....	133	3.74	.49	4.00	.78
1860.....	73	2.71	.33	3.59	.37	1873.....	95	2.54	.16	3.15	— .07
1861.....	83	2.45	.07	3.72	.50	Mean.....		2.58		3.22	
1862.....	40	2.32	— .06	2.98	— .24						
1863.....	63	2.13	— .25	2.64	— .58						

In order to determine the relation, if any, between thunder-storm action and fluctuations of the earth's magnetism Table ii. has been prepared. This shows in column one, the year; in column two, the total number of stations reporting thunder-storms; in column three, the mean number of storms per station; in column four, the departure from the mean for twenty-two years (a minus sign indicating deficiency); in column five, the mean diurnal range of the magnetic declination at Trevandrum, and in column six, the departure from the mean. It will be seen that with two exceptions the maximum and minimum points in the two phenomena coincide. This would seem to show a relation between the two and the necessity of observing fluctuations of the magnetic needle in connection with detailed observations of atmospheric electricity.

## OPTICAL PHENOMENA.

### SOLAR HALOS.

Solar halos were observed in the various states and territories, as follows:

**Arkansas.**—Fort Smith, 13th; Lead Hill, 13th, 18th, 22d, 25th, 28th, 30th.

**California.**—San Francisco, 4th, 14th, 17th, 19th, 30th; Cape Mendocino, 14th; Oakland, 14th, 30th.

**Florida.**—Pensacola, 1st, 4th, 13th; Archer, 10th.

**Idaho.**—Boisé City, 2d, 17th, 30th.

**Illinois.**—Riley, 14th; Anna, 27th.

**Indian Territory.**—Cantonment, 22d.

**Iowa.**—Davenport, 27th.

**Kansas.**—Sherlock, 22d.

**Louisiana.**—New Orleans, 3d.

**Michigan.**—Escanaba, 1st, 5th, 14th, 21st, 22d, 26th, 30th; Ann Arbor, 12th.

**Minnesota.**—Moorhead, 21st, 22d; Saint Vincent, 21st, 22d.

**Nebraska.**—Red Willow, 5th.

**New Jersey.**—Moorestown, 24th.

**New York.**—Buffalo, 4th, 15th, 19th, 22d, 23d; Oswego, 23d.

**North Carolina.**—Hatteras, 11th, 14th, 20th.

**Ohio.**—Toledo, 26th; Wauseon, 27th.

**Oregon.**—Albany, 4th, 26th.

**Pennsylvania.**—Erie, 15th, 23d.

**South Carolina.**—Stateburg, 4th, 26th.

**Tennessee.**—Nashville, 3d, 5th, 19th, 28th, 30th; Knoxville, 5th, 7th; Milan, 26th, Chattanooga, 30th.

**Virginia.**—Cape Henry, 4th, 6th, 24th; Dale Enterprise, 15th, 19th, 23d, 29th.

### LUNAR HALOS.

Lunar halos were observed in the various states and territories as follows:

**Alabama.**—Mobile, 29th.

**Arizona.**—Wickenburg, 1st, 2d; Fort Apache, 3d; Fort Grant, 12th.

**Arkansas.**—Lead Hill, 28th, 30th.

**Colorado.**—Grand Junction, 2d, 3d.

**Dakota.**—Deadwood, 11th.

**Delaware.**—Delaware Breakwater, 26th, 28th, 29th, 30th.

**District of Columbia.**—Washington City, 28th, 30th.

**Florida.**—Jacksonville, 1st, 2d, 28th, 29th, 30th; Cedar Keys, 1st, 4th; Pensacola, 2d; Key West, 2d, 3d, 6th, 8th; Archer, 6th; Limona, 6th.

**Georgia.**—Atlanta, 2d, 30th; Athens, 28th; Augusta, 28th.

**Idaho.**—Boisé City, 5th, 7th, 27th; Lewiston, 30th.

**Illinois.**—Riley, 3d, 14th, 26th, 27th; Anna, 28th; Chicago, 30th.

**Indiana.**—Jeffersonville, 2d to 5th, 28th; Wabash, 5th, 6th, 7th, 27th, 28th; Sunman, 28th.

**Iowa.**—Fort Madison, 26th.

**Kansas.**—Yates Centre, 5th; Fort Scott, 6th; Westmoreland, 17th; Salina, 27th; Allison and West Leavenworth, 30th.

**Kentucky.**—Louisville, 3d.

**Louisiana.**—New Orleans, 2d, 5th; Point Pleasant, 2d, 28th, 29th; Liberty Hill, 29th.

**Maine.**—Orono, 5th.

**Maryland.**—Ocean City, 23d, 28th; Woodstock, 28th.

**Massachusetts.**—Taunton, 4th, 5th, 28th.

**Michigan.**—Port Huron, 1st, 2d, 10th; Alpena, 3d; Ann Arbor, 30th; Hudson, 30th; Lansing, 30th.

**Mississippi.**—Vicksburg, 2d, 29th.

**Missouri.**—Saint Louis, 28th.

**Montana.**—Poplar River, 7th.

**Nebraska.**—Yutan, 5th.

**New Jersey.**—Sandy Hook, 4th; Somerville, 29th.

**New York.**—Albany, 27th.

**North Carolina.**—Brevard, 2d, 3d, 5th, 6th; New River Inlet, 4th; Flat Rock, 4th, 5th; Kitty Hawk, 28th; Stateville, 30th.

**Ohio.**—Wauseon, 4th, 30th; Cincinnati, 28th; Cleveland, 30th; Toledo, 30th.

**Oregon.**—Roseburg, 27th.

**South Carolina.**—Stateburg, 3d, 28th, 30th.

**Tennessee.**—Nashville, 3d, 4th, 5th, 7th, 24th, 27th, 29th, 30th; Chattanooga, 3d, 29th, 30th; Knoxville, 5th, 7th, 30th; Ashwood, 28th, 30th; Milan, 28th.

**Texas.**—Fort Stockton, 1st; Indianola, 1st to 5th, 25th; Rio Grande City, 4th; Palestine, 5th; Cleburne, 5th, 7th; Brownsville, 7th.

**Utah.**—Nephi, 1st, 2d, 3d; Salt Lake City, 2d, 28th, 30th.

**Virginia.**—Cape Henry, 2d, 3d, 6th, 28th; Chincoteague, 3d, 4th, 6th; Wytheville, 4th, 6th, 28th; Johnstown, 22d, 23d, 25th, 27th to 30th; Dale Enterprise, 26th, 28th, 29th, 30th; Norfolk, 28th.

**Washington Territory.**—Port Angeles, 2d; Spokane Falls, 28th.

**Wisconsin.**—Sussex, 27th.

**Wyoming.**—Cheyenne, 2d.

### MIRAGE.

Guttenburg, Iowa, 3d.

Northport, Michigan, 21st.

Sterling, Kansas, 30th.

## MISCELLANEOUS PHENOMENA.

### SUNSETS.

The characteristics of the sky, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from one hundred and fifty-eight stations show 4,701 observations to have been made, of which one was reported doubtful; of the remainder, 4,700, there were 4,047, or 86.1 per cent., followed by the expected weather.

The peculiar sunsets have continued during September, the